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May 8, 2009

FILED/ACCEPTED
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Federal Communications Commission
Office of the Secretary

Ms. Marlene H. Dortch, Secretary
Federal Communications Commission
445 Twelfth St. SW
Washington DC 20554

**Re: Request for Interpretation of Section 101.141(a)(3) of the Commission's
Rules to Permit the Use of Adaptive Modulation Systems**

Dear Ms. Dortch:

I am writing on behalf of these parties:

- **Alcatel-Lucent** is a global leader in fixed, mobile and converged broadband access, carrier and enterprise IP technologies and services, with 77,000 employees and operations in more than 130 countries.
- **Dragonwave Inc.** develops and manufactures high performance radio equipment for global, Ethernet-based network applications, and is currently a major supplier of this kind of radio equipment to the U.S. market.
- **Ericsson Inc.** is a leading supplier of telecommunications equipment and related services to mobile and fixed network operators globally.
- **Exalt Communications** provides next generation licensed and license-exempt microwave systems to service providers, government organizations and enterprises worldwide.

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- The **Fixed Wireless Communications Coalition** is a coalition of companies, associations, and individuals that speaks for the Fixed Service community.
- **Harris Stratex Networks** is a leading U.S. manufacturer of global carrier-class microwave and broadband fixed wireless equipment and is a major supplier for the U.S. market.
- **Motorola, Inc.** is a global manufacturer of wireless products and solutions, ranging from broadband communications infrastructure, enterprise mobility and public safety solutions to high-definition video and mobile devices.

This letter requests an interpretation of Section 101.141(a)(3) of the Commission's Rules. The proposed reading will provide for more consistently reliable service while adhering to both the letter and the purpose of the rule.

INTRODUCTION

Section 101.141(a)(3) imposes “capacity and loading requirements” on Fixed Service transmitters operating in the 4, 6, 10, and 11 GHz bands. These are the only bands suitable for links in the range of several miles up to tens of miles, and for that reason are critical to the Fixed Service.

Section 101.147 specifies authorized channel bandwidths. For each, Section 101.141(a)(3) specifies a “minimum payload capacity” expressed in megabits per second.¹ The minimum increases with bandwidth, from 1.54 Mb/sec for a 400 kHz channel, up to 134.1 Mb/sec for 30 MHz and 40 MHz channels.

The industry has generally construed the payload requirements as applying whenever the link is in service. For example, where the rule specifies a minimum capacity of 134.1 Mb/sec, the industry has taken this to mean the transmitter must be able to send at least 134.1 million bits during each and every second that the link is in operation and considered available.

There is no Commission decision that requires this reading.

We here propose that lower data rates be permitted during brief periods when the link would otherwise be temporarily out of service, such as during short, atmospherically-caused decreases in received signal strength. The data rate will still comply with the minimum during normal operation, and will also comply on average.

¹ For bandwidths of 10 MHz and above, the rule also requires that the channel be loaded to 50% of capacity within 30 months of licensing. That provision is not at issue here.

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DISCUSSION

A Fixed Service link is designed to achieve a specific availability objective: *i.e.*, the percentage of time the link may be relied upon for its designed throughput. During the fraction that the link is predicted to be unavailable, the throughput is assumed to be zero. For example, a link designed for 99.999% (“five nines”) availability is expected to be out of service, on average, not more than 0.001% of the time, or about five minutes over the course of a year. Links for critical applications are routinely designed to higher levels of availability.

Fixed Service links, especially long links, are subject to atmospheric “fading” – a temporary drop in received power caused by changes in propagation conditions. Fades lead to an increase in bit errors, and sometimes to a complete loss of communication.

In order to assure the design availability is met, most Fixed Service radio links incorporate a reserve power called “fade margin” to mitigate the effects of fading due to atmospheric conditions. This is excess capability not normally used, but available when needed. When a fade occurs in excess of the capacity of the fade margin, link communications are lost. Communications resume when the fading condition subsides. Some systems require re-synchronization, so that payload communications may be still interrupted for several minutes after the fade.

An additional way to combat fades is by briefly reducing the data rate. This requires a temporary change in the type of modulation, a process called “adaptive modulation.” Reducing the data rate maintains communication because receivers can accept a weaker incoming signal when the bit rate is lower. This allows the bit stream to continue in the event of a fade, albeit at a lower data rate. Adaptive modulation also maintains system synchronization, eliminating the possible need for several minutes of down-time for synchronization “reboot.”

The use of adaptive modulation may reduce the link capacity below the value specified in the rule for a short time, although this still represents an increase over the otherwise zero level during the fade. Even with adaptive modulation in use, the average bit rate over time will continue to exceed the minimum. Most modern digital radios routinely operate at well above the minimum required capacity, and most deep fades are of short duration. For example, digital radios occupying a 30 MHz channel at 6 GHz typically operate at about 155 Mbps, a 16% excess over the required 134.1 Mbps. In a properly designed system, fading conditions that might trigger adaptive modulation occur well under one percent of the time. Thus, even under pessimistic assumptions, a system employing adaptive modulation will comfortably achieve the minimum on average.

REQUEST

The parties to this letter ask the Bureau to confirm that the use of adaptive modulation is consistent with Section 101.141(a)(3). This reading permits a transmitter to temporarily reduce the data rate below the value in the rule during brief periods when the link would otherwise be completely inoperative. Links

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would still have to comply with the minimum payload capacity in ordinary operation, and would also have to maintain the minimum on average.

PUBLIC INTEREST

The proposed reading of Section 101.141(a)(3) fully maintains the purpose of the rule by enhancing spectrum efficiency. It allows for the continued handling of critical traffic when the link would otherwise be inoperative. And it preserves network synchronization through a fade, eliminating several additional minutes of outage that can threaten real-time applications such as public safety backhaul, electric grid and pipeline control, and cell site backhaul. As noted, performance on average will equal or exceed the minimum.

ADMINISTRATIVE NOTE

The parties acknowledge that a license application and prior coordination for a system that uses adaptive modulation must list all of the modulations that the system might use, with their respective emissions designators.

LEGAL NOTE

The requested interpretation falls easily within the present wording of the rule, and does not cause any possible disadvantage to other users of the spectrum. The Bureau is free to interpret a rule, without a waiver or rulemaking proceeding, so long as the interpretation conforms to the original language and intent.² This request satisfies that requirement. The Bureau can grant the requested relief summarily and under delegated authority.

FOREIGN ACTION

Industry Canada has approved adaptive modulation under the same conditions requested here.³ ETSI, the standards development body for the European community, has also approved adaptive

² *Central Texas Tel. Coop. v. FCC*, 402 F.3d 205 (D.C. Cir. 2005) (holding a Commission order to be “interpretive,” and therefore not subject to rulemaking procedures, because it “sensibly conforms to the purpose and wording” of an earlier order, citing *Northern Ind. Pub. Serv. v. Porter County Chapter of the Izaak Walton League of Am.*, 423 U.S. 12 (1975)).

³ Letter from Michael Christensen, Manager, Fixed Wireless Communications, Spectrum Engineering Branch, Industry Canada to Scott Duffus, Alcatel-Lucent, Industry Canada File No. 159790 (not dated). A copy is attached.

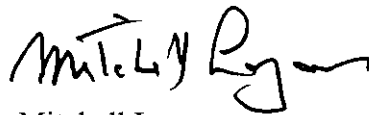
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modulation under the name "mixed-mode,"⁴ and a number of European administrations approve the use of adaptive modulation.

CONCLUSION

The signing parties ask the Bureau to interpret Section 101.141(a)(3) as permitting data rates to drop for brief periods below the values in the rule under the conditions described above, so long as the values in the rule are maintained both in normal operation and on average.

Respectfully submitted,



Mitchell Lazarus

On behalf of Alcatel-Lucent, Dragonwave Inc.,
Ericsson Inc., Exalt Communications, Fixed Wireless
Communications Coalition, Harris Stratex Networks,
and Motorola, Inc.⁵

cc: Acting Chairman Michael J. Copps
Comm'r Jonathan S. Adelstein
Comm'r Robert McDowell
Jim Schlichting
Joel Taubenblatt
Blaise Scinto
John Schauble
Michael Pollak
Stephen Buenzo

⁴ *Fixed Radio Systems; Characteristics and requirements for point-to-point equipment and antennas; Part 2-2: Digital systems operating in frequency bands where frequency co-ordination is applied; Harmonized EN covering the essential requirements of Article 3.2 of the R&TTE Directive, Harmonized European Standard (Telecommunications series), Final draft ETSI EN 302 217-2-2 V1.3.1 at § I.3.1, ¶ (b) (December 2008). The cover sheet and relevant section are attached. We will provide a copy of the full standard on request.*

⁵ Although specifically authorized to file this letter on behalf of each party named, this firm does not otherwise represent some of those parties.



Industry Canada Industrie Canada

300 Slater Street
Ottawa, ON K1A 0C8

Our file: 159790

Scott Duffus
RSC NA-Wireless
Alcatel-Lucent
1380 Rodick Road
Markham, ON
L3R 4G5

Dear Mr. Duffus,

Thank you for your recent query regarding the eligibility for licensing of point-to-point microwave radio systems employing adaptive modulation techniques. I can confirm that such systems are eligible for licensing by Industry Canada, even though their spectral efficiency may occasionally fall below the minimum level specified in the relevant Standard Radio System Plan (SRSP).

Such systems must comply with the minimum spectral efficiency during normal operation. Operation below this level of spectral efficiency should only take place a small portion of the time, for example during adverse propagation conditions.

Systems using adaptive modulation techniques will be licensed based on their maximum bit rate capacity and the corresponding modulation scheme. These systems must comply at all times with other provisions of the relevant SRSP, including out-of band and spurious emission limits, regardless of modulation technique used.

I trust that this information is of assistance.

Sincerely,

Michael Christensen
Manager, Manager,
Fixed Wireless Communications
Spectrum Engineering Branch

cc: Albert Lau: VAN
Bill Klymochko: WPG
Elisabeth Lander: TOR
Fernando Mendes: MTL-D
Mike Leblanc: MCN

Canada

**Fixed Radio Systems;
Characteristics and requirements for
point-to-point equipment and antennas;
Part 2-2: Digital systems operating in frequency bands where
frequency co-ordination is applied;
Harmonized EN covering the essential requirements
of Article 3.2 of the R&TTE Directive**



I.3 Mixed-mode operation impact

I.3.1 Basic concepts

When assigned a radio frequency channel of a certain width over a link of defined length, the use of adaptive modulation (*mixed-mode*) in PP links can, in principle, while occupying the same channel, offer more efficient operative conditions dictated by two different optional objectives:

- a) The increase the available capacity over the same radio frequency channel, during period with favourable propagation conditions, by the use of modulation formats higher than that used for defining the link budget and related frequency co-ordination constraints at the conventional availability objective (c.g. 99,99 %). Maintaining symbol rate about the same, this will result in the same channel occupancy and in a higher capacity even if with lower availability (according the statistic of propagation phenomena, multipath or rain) due to reduced link budget (according the higher BER threshold and reduced TX power for improving linearity).

EXAMPLE: On a link designed and frequency co-ordinated for the 99,99 % availability for 'K' Mbit/s capacity with 4QAM format, the system, maintaining the same symbol-rate, will also operate for:

- # '2*K' Mbit/s capacity with 16 QAM format for lower time % due to the ~10 dB reduction in link budget (i.e. ~6 dB S/N and ~4dB TX back-off) resulting, in Rayleigh multipath propagation, in ~99,9 %.
- # '3*K' Mbit/s capacity with 64 QAM format or '4*K' Mbit/s capacity with 256 QAM for even lower time %, due to the ~8 dB or ~ 15 dB further reduction in link budget (as a mixture of consequent S/N increase and TX back-off).

- b) To increase the availability of a smaller portion of the capacity, during period with very unfavourable propagation conditions, by the use of modulation formats lower than that used for defining the link budget and related frequency co-ordination constraints at the conventional availability objective (c.g. 99,99 %). This will result in lower capacity with higher availability (according the statistic of propagation phenomena, multipath or rain) due to enhanced link budget (according the lower BER threshold and, as far as possible, TX power increase consequent to reduced linearity requirement).

EXAMPLE: On a link designed and frequency co-ordinated for 99,99 % availability for 'K' Mbit/s capacity and 64QAM format, the system, maintaining the same symbol-rate, will also operate for:

- # '2/3*K' Mbit/s capacity and 16 QAM format for higher time % due to the increase in link budget (i.e. ~6 dB S/N and, if possible, ~4dB TX back-off) resulting, in Rayleigh multipath propagation, in ~99,999 %.
- # '1/3*K' Mbit/s capacity and 4 QAM format for an even higher time %, due to the further increase in link budget (as a mixture of consequent S/N increase and, if possible, TX back-off).

Intermediate situations are possible; e.g. the link designed and co-ordinated with 16 QAM format might dynamically change to 64 QAM or higher for objectives in option a) and to 4 QAM or lower for objectives in option b).

It is to be noted that go and return channels may operate independently, being driven by different propagation situation; therefore TX and RX modulation formats, at a certain time, may not be the same.

In addition, it should be noted that *mixed-mode* systems will likely need highly reliable exchange of information between TX and RX, necessary for managing the change of format dynamically with propagation. For this purpose, it might be advisable that service channels for internal system management (c.g. within the headers of the radio frame, similarly to preambles in PMP systems) are always transmitted with symbols of the less sensitive format (c.g. 4QAM or even BPSK) even when the remaining radio frame (payload) is transmitted with symbols of higher order formats.